CLAIMS

1. A system for transmitting and/or receiving electromagnetic waves comprising:
   - a device (62) for focusing the electromagnetic waves transmitted and/or received by the system on a focal point, and
   - a transmitter and/or receiver of electromagnetic waves placed roughly at the focal point so as to transmit and/or receive said electromagnetic waves,

   characterized
   - in that it comprises a multiple-beam antenna (4), the outer radiating surface of which is placed roughly on the focal point so as to form said transmitter and/or receiver of electromagnetic waves,
   - in that the antenna comprises:
     - a photonic bandgap material (20, 42, 172) designed to filter the electromagnetic waves spacewise and frequencywise, this photonic bandgap material having at least one bandgap and forming an outer surface (38, 158) radiating in transmit and/or receive mode,
     - at least one periodicity defect (36, 76, 78, 156, 180) of the photonic bandgap material so as to produce at least one narrow bandwidth within said at least one bandgap of this photonic bandgap material, and
     - an excitation device (40 to 43, 84, 86, 160, 162, 190) for transmitting and/or receiving electromagnetic waves within said at least one narrow bandwidth produced by said at least one defect, this excitation device being designed to work simultaneously at least about a first and a second separate working frequencies,
   - in that the excitation device includes a first and a second excitation elements (40 to 43, 84, 86), separate from and independent of each

other, each designed to transmit and/or receive electromagnetic waves, the first excitation element being designed to work at the first working frequency and the second excitation element being designed to work at the second working frequency,

- in that the or each periodicity defect (36, 76, 78) of the photonic bandgap material forms a leaky resonating cavity (36, 76, 78) presenting a constant height in a direction perpendicular to said radiating outer surface (38), and predefined lateral dimensions parallel to said radiating outer surface,
- in that the first and the second working frequencies are designed to excite the same resonance mode of a leaky resonant cavity (36, 76, 78), this resonance mode being established identically regardless of the lateral dimensions of the cavity, so as to create on said outer surface respectively a first and a second radiating spots (46 to 49), each of these radiating spots representing the origin of a beam of electromagnetic waves radiated in transmit and/or receive mode by the antenna,
- in that each of the radiating spots (46 to 49) has a geometric center, the position of which depends on the position of the excitation element producing it and the area of which is greater than that of the radiating element producing it, and
- in that the first and the second excitation elements (40 to 43, 84, 86) are placed relative to each other such that the first and the second radiating spots (46 to 49) are positioned on the outer surface (38) of the photonic bandgap material alongside each other and partially overlap.

2. The system as claimed in claim 1, characterized in that the device for focusing the electromagnetic waves is a parabolic reflector (62).

3. The system as claimed in claim 1, characterized in that the device for focusing the electromagnetic waves is an electromagnetic lens.

4. The system as claimed in any one of the preceding claims, characterized in that:
- each radiating spot (46 to 49) is roughly circular, the geometric center corresponding to a maximum transmitted and/or received power and the periphery corresponding to a maximum transmitted and/or received power equal to a fraction of the maximum transmitted and/or received power at its center, and
- the distance, in a plane parallel to the outer surface, separating the geometric centers of the two excitation elements (40 to 43, 84, 86) is strictly less than the radius of the radiating spot produced by the first excitation element added to the radius of the radiating spot produced by the second excitation element.

5. The system as claimed in any one of the preceding claims, characterized in that the geometric center of each radiating spot (46 to 49) is placed on the line perpendicular to said radiating outer surface (38) and passing through the geometric center of the excitation element (40 to 43) producing it.

6. The system as claimed in any one of the preceding claims, characterized in that the first and the second excitation elements (40 to 43) are placed inside one and the same cavity (36).

7. The system as claimed in claim 6, characterized in that the first and the second working frequencies

are situated within the same narrow bandwidth created by this same cavity (36).

8. The system as claimed in any one of claims 1 to 5, characterized in that the first and the second excitation elements (84, 86) are each placed inside separate resonating cavities (76, 78), and in that the first and the second working frequencies are designed each to excite a resonance mode independent of the lateral dimensions of their respective cavities.

9. An antenna as claimed in claim 8, characterized in that it comprises an electromagnetic radiation reflector plane (74) associated with the photonic bandgap material (72), this reflector plane being distorted so as to form said separate cavities.

10. The system as claimed in any one of the preceding claims, characterized in that the or each cavity is of parallelepipedal shape.

11. The system as claimed in any one of claims 1 to 9, characterized in that the device for focusing the electromagnetic waves comprises a reflector (202) in half-cylinder shape, and in that the photonic bandgap material of the antenna (204) has a convex surface corresponding to the half-cylinder-shaped surface of the reflector (202).